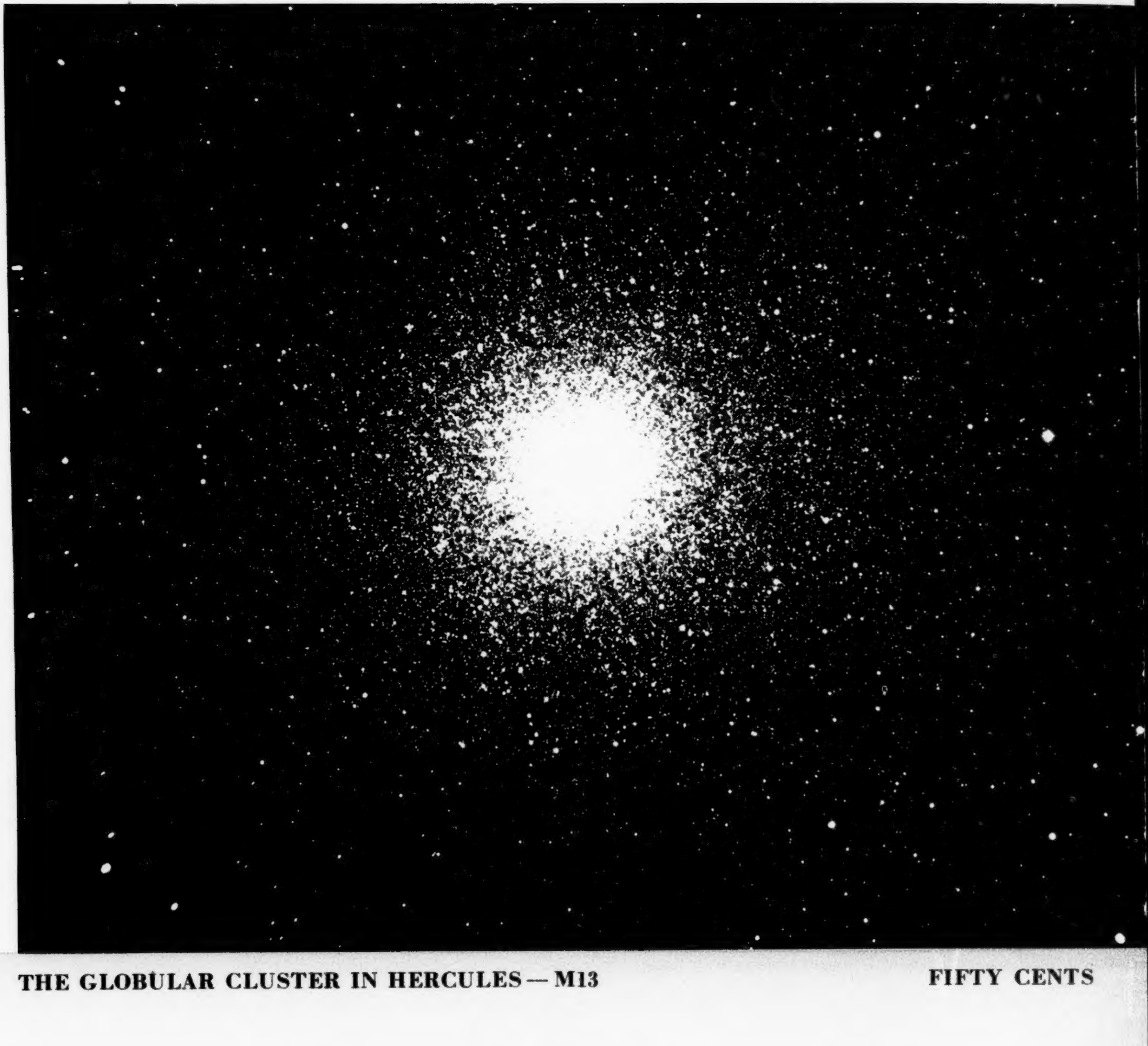
THE MONTHLY

MAP

The Stars Brought Down To Earth

VOL. LIV NO. 505



THE GLOBULAR CLUSTER IN HERCULES — M13

FIFTY CENTS

MAY • JUNE

FOUNDED IN 1905 BY
LEON BARRITT

THE MONTHLY EVENING SKY MAP

MAY • JUNE 1960
VOL. LIV WHOLE NUMBER 505

THE MONTHLY EVENING SKY MAP
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One year: $3.00
Two years: $5.00
Three years: $6.00

(Postage, other than in U.S. and Possessions, Canada and Mexico, $1.00 per year additional.)

Published bi-monthly by Sky Map Publications, Inc., Post Office Box 213 (Clayton Branch), St. Louis 5, Mo.

Second Class Postage Paid at St. Louis, Mo.

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COVER PHOTO

The cover photograph of the globular cluster M13 in Hercules was made at Mt. Palomar with the 200-inch telescope. The inner portion of the cluster is "burned out" by the long exposure required to record the fainter stars at its perimeter. See this issue's "Through The Three-Inch" feature for further details.

LIGHTHOUSES IN THE SKIES

Dr. Alan T. Waterman, director of the National Science Foundation, touched upon a significant period of American astronomical development in his Kitt Peak dedicatory address (page 4) when he brought up the subject of President John Quincy Adams and his "lighthouses of the skies." It was in 1825 that Adams proposed, in his message to Congress, that the United States finance and construct an astronomical observatory. Just 135 years later, his dream became a reality with the dedication in mid-March of the Kitt Peak National Observatory. Adding that a cynic might suggest that "this was about par for the course on anything requiring Federal action," Waterman made the important point that this delayed action does not completely bear out Adams' somewhat bitter words:

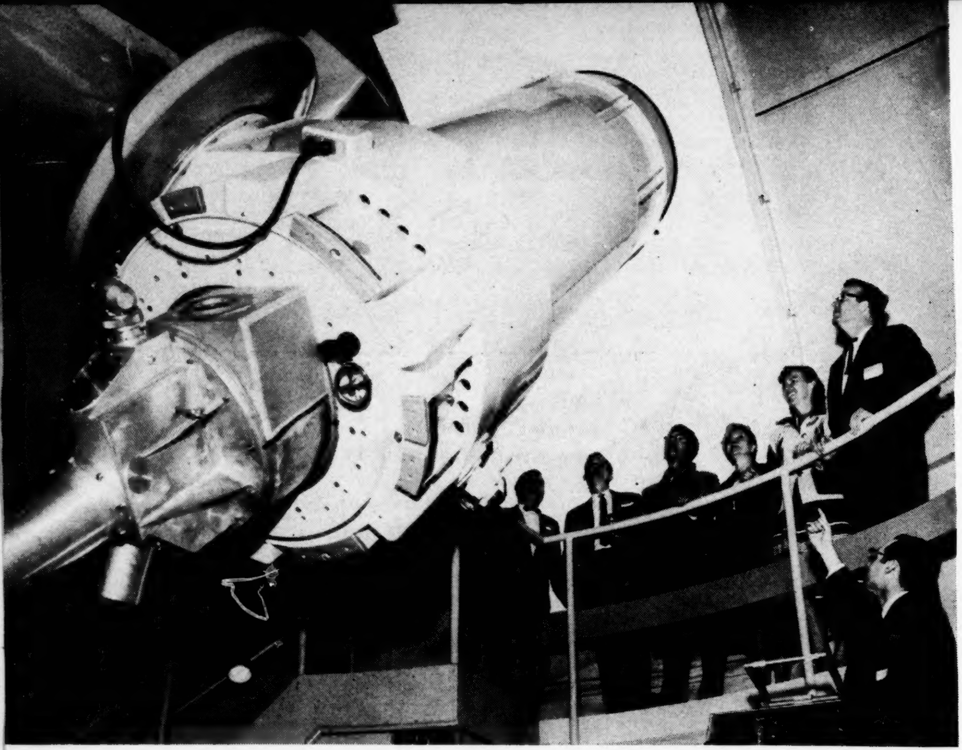
> "It is with no feeling of pride as an American that the remark may be made that, on the comparatively small surface of Europe, there are existing upward of 130 of these lighthouses of the skies, while throughout the whole of the American hemisphere there is not one."

One must recollect in tranquillity for a moment. To a young nation still struggling to retain its newly-gained freedom and to develop its frontiers, astronomical research was not a prime budget consideration. It was also quite natural for a man of Adams' enlightenment and education to think of observatories as state-endowed institutions. In Europe, all observatories of any size at the time were financed by the national governments — Greenwich, Paris, Pulkovo, to name a few.

However, less than 20 years later, in his last public act, John Quincy Adams was to dedicate the first major observatory in the United States at Cincinnati. This observatory, subscribed with funds donated by the citizens of Cincinnati, was the first of many larger such institutions built with private funds—"lighthouses of the skies" which guided America to the front ranks of astronomical research. With their private endowments, universities such as Harvard, Yale, and Princeton soon became centers for astronomical studies. An eccentric millionaire named Lick caused the first of the great mountain-top observatories to be built, and a transit company magnate named Yerkes, after a few doses of George Ellery Hale, gave the United States the world's largest refractor. Then came the private foundation funds of Carnegie and Rockefeller, with Mount Wilson and Palomar Mountain following in their wake.

It has been desirable, and still should be, that the people have a direct part in furthering the study of the stars. Now, however, current developments and the needs they have created cannot be satisfied with private money alone. It is a credit to the National Science Foundation and the Congress that additional money for basic research in astronomy is available and intelligently spent.

It is also a pleasant irony to note that Adams felt he lost his case because he had been misquoted as having suggested "lighthouses *in* the skies," for this will actually be the goal—through the orbital space telescope—of the National Observatory which he originally inspired!



Dr. A. B. Meinel (right on balcony), director of Kitt Peak Observatory, accompanies group of astronomers on inspection of 36-inch Cassegrain reflector, first of a series of large research instruments to be installed at the new facility. Photos courtesy of AURA, Inc., and National Science Foundation.

KITT PEAK OBSERVATORY

On March 15 distinguished scientists from all parts of the United States gathered on a mountain-top in southern Arizona to officially dedicate an unique astronomical observatory. The new Kitt Peak National Observatory, which stands atop a rugged 6,875-foot mountain 40 miles southwest of Tucson, is one of two major astronomical facilities supported by the National Science Foundation to meet the growing needs of present-day astronomy. The other installation is the recently activated National Radio Astronomy Observatory at Green Bank, W. Va., which is directed by Dr. Otto Struve.

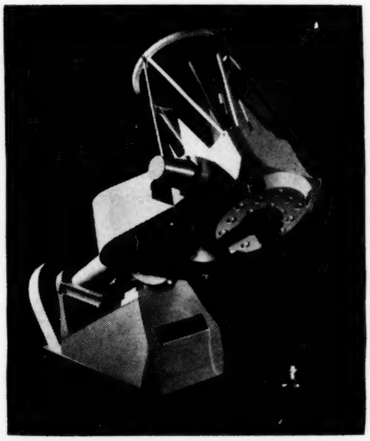
The uniqueness of the Kitt Peak complex of instruments lies in the fact that it is the first optical observatory to be constructed with government funds for use by all qualified astronomers. This is a significant development, since previous to this the only major observatory financed by the government has been the U. S. Naval Observatory in Washington, which also has a branch in Flagstaff, Arizona. This observatory, however, was primarily designed for positional astronomy work directly related to the maintenance of our time system and the support of navigational needs. Its instruments are used almost completely by the Naval Observatory staff.

The new National Observatory is designed to meet with maximum efficiency the varied requirements of modern astronomical research. With two rather dramatic exceptions, its instrumentation is rather modest if compared to recent optical leviathans. Its first major instrument, a 36-inch reflector, was installed just a few weeks before the dedication ceremonies, and an 80-inch reflector is presently under construction. Two 16-inch reflectors in use at the site during the construction period will be retained. All instruments, however, are of advanced design, and will incorporate modern electronic techniques that will effectively "increase" their light-gathering power and thus extend their utility.

At one time a mammoth telescope was under consideration, but the planners wisely decided that the goal of the National Observatory instrumentation should be efficiency, compactness and adaptability. Speed and ease of operation, combined with adaptability to various types of research, are important factors to the visiting astronomer with a limited time for study and a casual acquaintance with the equipment.

The observatory will also share its peak with the 36-inch reflector of the Steward Observatory, presently located on the campus of University of Arizona in Tucson. This telescope, which has made many contributions to astronomical research, will be replaced at the campus location by a smaller instrument for use primarily in student instruction.

But these Arizona astronomers have plans to match their mountains. One development, for which preparatory drilling had begun at the time of the dedication, is that of a giant, 300-foot focal length solar telescope, to be at completion the largest in the world. Its tube will be a 500-foot structure, more than half of which will be burrowed into the rock of Kitt Peak. The exposed portion will rise to meet a 100-foot vertical tower, which supports an 80-inch plane mirror of fused silica. This mirror, guided on the sun with a clock drive, will feed the solar rays to a 60-inch concave mirror at the lower end of the tube. Through a third mirror of 48-inch aperture located within the tube at about ground level, the focused image will be directed into a subterranean observing room for analysis by visual, photographic or spectrographic methods. The final



Scale model of large 80-inch Cassegrain reflector which is now under construction. Apparatus to record spectra of stars will have its focus some 200 feet from mirror, underneath floor of the observatory.

image will be nearly three feet in diameter, several times larger and more brilliant than any other solar telescopes in existence.

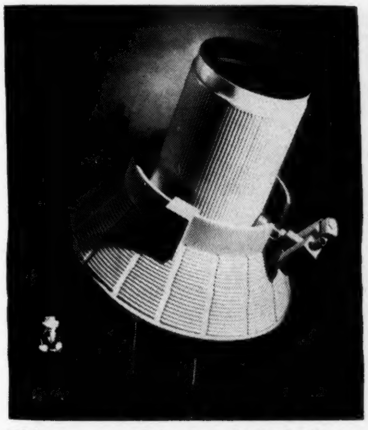
Despite the National Observatory's mile-high location in a clear, dry climate that has attracted other major observatories to Arizona, the limitations long imposed on man at the bottom of his sea of air will still take their toll. To solve these problems the Kitt Peak astronomers have advanced a novel suggestion which has now progressed to the detailed planning stages—the suggestion that the observatory build and operate a 50-inch space telescope which would be placed into an orbit about 22,400 miles from the earth's surface. The original grant for study in this area has now been expanded by NSF to funds for the engineering of a prototype space instrument.

In commenting on these plans, Dr. Aden B. Meinel, director of the Kitt Peak National Observatory, summed up the program in these words:

"A reflecting telescope of approximately 50-inch diameter in orbit outside the dense, obscuring portion of the earth's atmosphere is the ultimate goal. Such an instrument would offer basic research advantages unobtainable with much larger surface-mounted instruments."

Meinel, who had spent several years testing more than 150 sites in the western states for quality of seeing, also stated that the advantages of such a space telescope would far outweigh those of an earth-bound telescope of giant proportions, without any considerable difference in costs. He added, however, that he "cannot estimate with accuracy" when the space telescope may be orbited, since this "depends on many factors, including major decisions which are the responsibilities of others."

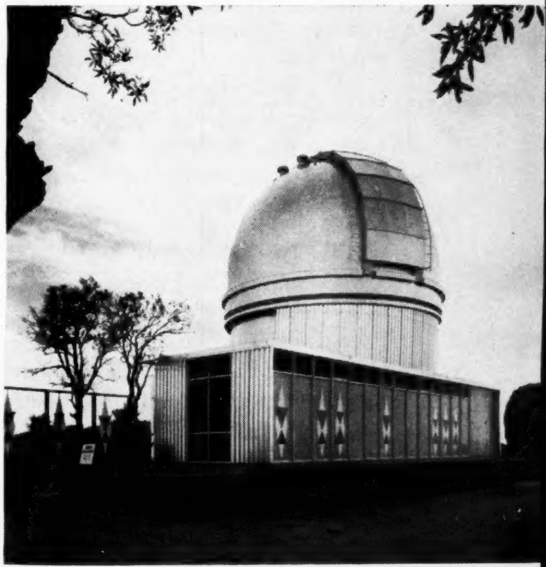
The Kitt Peak facilities are operated for the sponsoring National Science Foundation by AURA (the Association of Universities for Research in Astronomy, Inc.), a non-profit research and educational corporation made up of nine American universities long prominent in astronomical activity. AURA maintains its offices at the edge of the campus of the University of Arizona, directly across the street from the Steward Observatory. This modern structure, a contrast to facilities usually available in the pre-space-age years to astronomers, houses administrative and research offices, the library, and a shop.



This is a model of a 50-inch "space telescope" which has now gone beyond the planning stage. A prototype instrument is in the process of development.

In his dedicatory address (see page 3), Dr. Alan T. Waterman, director of the National Science Foundation, cited an estimate by Dr. Otto Struve, whose calculations suggested that the 36-inch and 80-inch telescopes will provide about 5,000 hours per year of additional observing time in the nation's overall optical astronomy program. Of this impres-

(Continued on Page 6)



Dome and colorful building to house Kitt Peak's 36-inch reflector. This Arizona mountain site offers exception observing conditions in winter, complementing better summer season of California's coastal observatories.

(*Continued From Page* 5)

sive total, about 3,000 hours will be available to visiting astronomers for research in their specialized fields.

Already an attraction because of the excellent seeing and many large observatories, Arizona should soon become a veritable Mecca for vacationing amateurs. Visible on a clear day from the Tucson area, Kitt Peak has a good road to its summit (although cars with automatic transmissions are not presently allowed) and will shortly have public facilities that will include a museum. The mountain is located on the reservation of the Papago Indians, a situation which nearly rendered useless the lofty plans and foundation moneys of the National Observatory.

Initial meetings with the Papago tribal council shortly brought out the fact that the mountain was of great religious significance to the tribe, and the tribal fathers refused permission to use the mountain. Then Dr. Edwin F. Carpenter, director of the Steward Observatory, held what might be termed one of the most significant and unusual "star parties" in the history of astronomy. Several representatives of the Papago tribe were brought to the Steward Observatory, and Dr. Carpenter, also a director-at-large of AURA, trained the 36-inch reflector on the moon and had the Papagos look at it. Before they had a chance to recover from their awe, Dr. Carpenter proceeded to give the Papagos a brief lecture on astronomy. It wasn't long after that that "the people with the long eyes" were granted the use of Kitt Peak.

The wise sachems of the Papago reservation showed that they had a few additional "reservations," however, and still retained the grazing, cutting and hunting rights (it is presumed that astronomers are not in season), and when the museum facilities are opened the astronomical exhibits will share space with a shop for the sale of Papago Indian baskets!

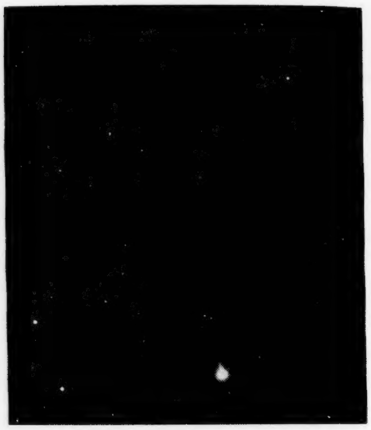
COMET FAINT

According to first observations of Comet Burnham 1959k after it passed perihelion in late March, the object has so far not lived up to its early promise. Expected to be a possible 3rd-magnitude object during April, the comet was observed visually by Alan McClure of Los Angeles on the morning of April 7th and was estimated to be about 6th magnitude. The comet was low in the east, just under the water jar in Aquarius, and not an easy object in the early dawn sky.

Mr. McClure, who has attained an excellent reputation as an astro-photographer, was able to make a photograph of Comet Burnham (see photo) which, on the original print, showed a tail some 3° in length. (Much of the detail, however, is lost here in reproduction.) He reported that this tail was not visible to the naked eye and that the comet itself had the appearance of "a small, unresolved globular cluster."

McClure made his visual estimate of magnitude 6.2 from an altitude of more than 8,000 feet atop Mt. Pinos. He used 12 x 70 binoculars. His photograph was also made from this vantage point, with equipment described in the caption accompanying the picture.

On April 26th Comet Burnham passes just north of Deneb in Cygnus and into the circumpolar skies (for observers in northern latitudes).



Mr. McClure made this photograph of Comet Burnham on April 8th with a guided camera using an f/7 Fecker triplet lens of 7-inch focal length. Exposure was for 17 minutes.

On April 30th it can be located at the northern edge of the bowl of the Little Dipper, and on May 4-5th it can be seen cutting directly through the bowl of the Big Dipper. The object should begin to fade rapidly after this time, because it has long since passed perihelion, and only its increasingly close approach to the earth during April led its orbit computers to predict little change in brightness through April. Observers will be interested to see if its 20,000,000-mile approach to the earth actually offsets its increasing distance from the sun.

[Observations on April 18th indicate Comet Burnham is brightening—Ed.]

First Sky Map Editor Dies

Dr. S. A. Mitchell, solar eclipse observer, former director of the Leander McCormick Observatory and the first editor of the MONTHLY EVENING SKY MAP, died in late February at the age of 85. Although primarily known for his work on many successful solar eclipse expeditions and for his popular book *Eclipses of the Sun*, Dr. Mitchell also directed important research programs, including the measurement of stellar parallaxes and the determination of comparison star magnitudes for use in variable star work.

From 1909 to 1911 Dr. Mitchell was editor of the MONTHLY EVENING SKY MAP. Up to that time the SKY MAP had been a syndicated newspaper feature, but it was converted to a small monthly journal by owner Leon Barritt, who retained Mitchell as its editor.

MINOR PLANETS... ANSWER TO MAJOR PROBLEMS?

By James G. Peters

Many amateurs know what asteroids are, but few realize that they are being studied with renewed interest today. True, they aren't as spectacular to look at as spiral galaxies, star clusters, sunspots, or the planet Mars, but there are still many unanswered questions about them, and many can be studied with modest equipment.

A field which is proving to be of practical importance is the problem of putting man into space. In order to do a successful job of this, we must know something about the distribution of matter in interplanetary space. This field will, of course, include asteroids, comets, and other interplanetary particles.

Observations of asteroids are also used to put a scale of distance on the solar system. For example, the distance of the asteroid Eros is far easier to measure than the distances of other solar system objects because it comes closer to the earth than any of the major planets. Knowing its orbit and measuring its distance, we can compute the length of the astronomical unit—the mean distance between the earth and the sun—much more accurately than it could be measured.

Another good value for the astronomical unit is obtained from the study of the perturbation of asteroidal orbits by the earth-moon system. The astronomical unit is in turn used as the base line for measuring the distances of the stars, making it a fundamental measuring unit for astronomers.

Let us consider only one more general aspect of the studies of asteroids. An even more fundamental problem than we have yet considered is that of the origin of the universe, and therefore of the origin of the solar system. To explain the origin of the solar system, we must account not only for the existence of the sun and planets, but also for the existence of any related interplanetary material, such as comets, asteroids, and interplanetary dust. To explain the origin of asteroids, we must know something about them. If we know very little about them, then many theories might explain their existence equally well. It is thus important to learn everything possible about them so we can decide which theory gives the best explanation. Actually, the theories themselves will suggest some observation programs, but in general we should know how they move and more about their physical characteristics.

We know quite a bit about how asteroids move. A number of observatories scattered throughout the world regularly take pictures of asteroids to determine their positions and thus to compute their orbits. These observations are sent to the Minor Planet Center of the University of Cincinnati. From this central clearing house the orbits and magnitudes of these observed asteroids are published in the *Minor Planet Circulars.*

A few observatories are also tackling the problem of giving a physical description of these minor planets. Since they are very small compared to planets, and yet are at distances comparable to them, only a few asteroids show even a small disk upon observation through the largest telescopes, and we can't hope to tell much about their surface features. For the most part, the images of asteroids appear like the images of stars. Therefore, astronomers intensely study the character of the sunlight the asteroids reflect in order to learn as much about them as is indirectly possible.

Much work of this sort has recently been done in a systematic survey of asteroids conducted by the Yerkes and McDonald Observatories of the University of Chicago and the University of Texas. The survey was conducted to observe photographically all asteroids down to a prescribed limiting magnitude in order to get complete statistical data for them and to set up a uniform scale for asteroid magnitudes. By statistical studies of this data, astronomers can learn information about the frequency distribution of their sizes and whether their axes of rotation are fixed in space or wobble. Some of the magnitude work of the survey has been extended to fainter asteroids at the Goethe Link Observatory of Indiana University.

An asteroid leaves its tell-tale record on the photographic plate. This object, fairly bright, was caught during an exposure guided on the stars. Faint asteroids are often picked up by cameras guided on the supposed orbit of the asteroid itself, allowing the stars to trail and the faint light of the asteroid to build up on the plate. Harvard College Observatory Photograph.

Included in the survey's observation program were more accurate photoelectric observations of some of the brighter asteroids. From small variations in an asteroid's brightness astronomers can find the period of rotation of the asteroid. From observations of the light variations, used in conjunction with variations in color, they can get an idea of its shape and the spottiness of its surface. Asteroids go through phases, as does Mars, being full at opposition and somewhat less than full at other times. Of course, they never reach new phase, since they don't pass between the earth and the sun. Through records of the variation of light as asteroids change phase, from observations of their colors, and from measurements of the degree of polarization of their light, astronomers are attempting to discover the nature of their surfaces.

So we see that, by an intensive study of the light reflected by these objects, astronomers can learn much about them. This type of work is being carried on now, but there is much to be done before we can give a good physical description of the asteroids.

METEOR FRAGMENTS

By Edwin E. Friton

The only major meteor shower during May and June is that of the Eta Aquarids, which reaches its maximum on May 4th. These meteors are especially enjoyable to watch because they are very swift and have extremely long paths.

The radiant rises at about 2:00 a.m. but does not reach its culmination point until about 7:30 a.m., long after sunrise. Dawn begins about 3:15 a.m. for mid-northern latitudes in early May, so observations of this shower must be restricted to the period from about 2:00 to 3:45 a.m. The first-quarter moon will not interfere.

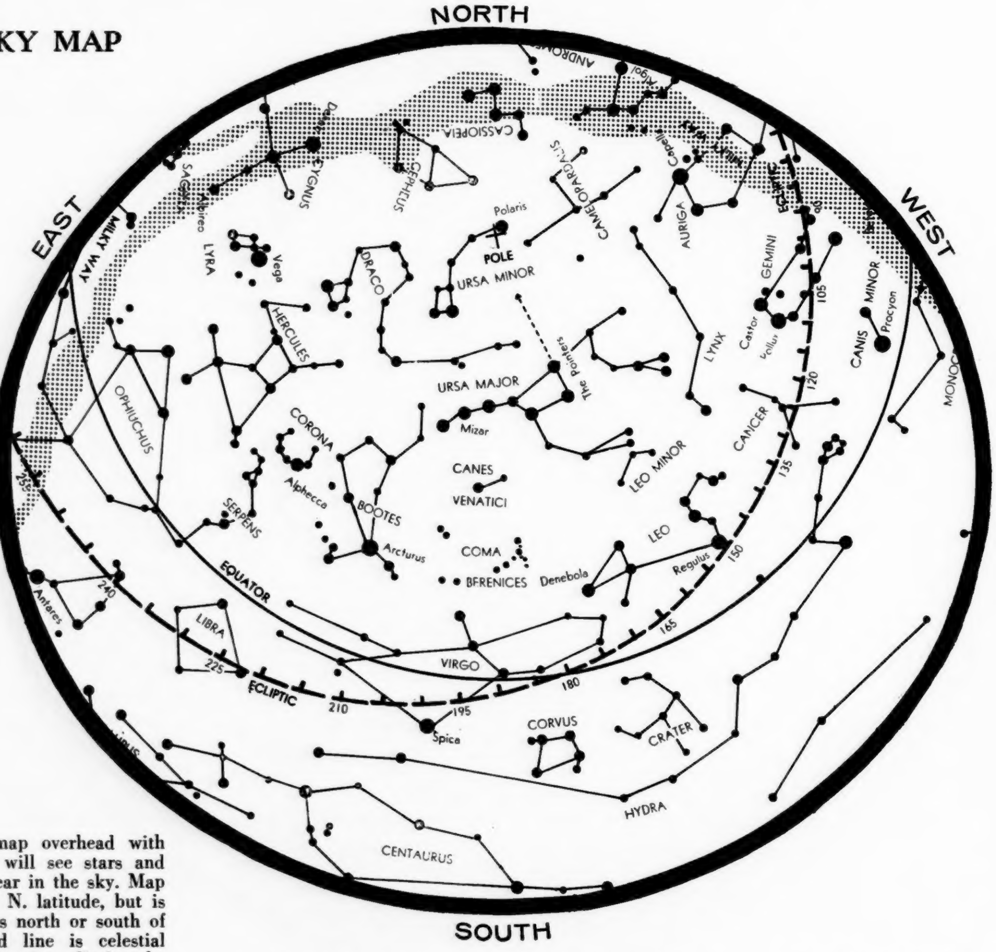
Observers in the southern hemisphere are more fortunate, since night lasts longer there this time of year and the Eta Aquarid radiant will be farther above the horizon when dawn comes. The higher a radiant in the sky, the greater the meteor rate, all other factors being equal. The maximum rate for this shower is about 20 per hour in mid-northern latitudes, while in the southern hemisphere it may run as high as 30 per hour.

The radiant is known to have a very definite daily motion during the period of the shower, but at the time of maximum its position is at 22h 24m right ascension and 0° declination—right on the equator and near Eta Aquarius. The duration of the shower is approximately from April 25th to May 13th, indicating that the stream is quite broad—about 35 million miles, according to A. C. B. Lovell.

Lovell also states that exceedingly few velocity determinations have been made for the Eta Aquarid meteors, either through visual or radio techniques, but measurements which have been made indicate velocities of about 39 miles per second. Certainly more simultaneous observations of good quality need to be made in connection with this shower.

Incidentally, it has often been stated thas this stream is associated with Halley's comet, but any such relation is still a matter for controversy.

EVENING SKY MAP FOR MAY



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

10:00 P.M., May 1 9:00 P.M., May 15 8:00 P.M., May 31

Astronomical League Convention Scheduled

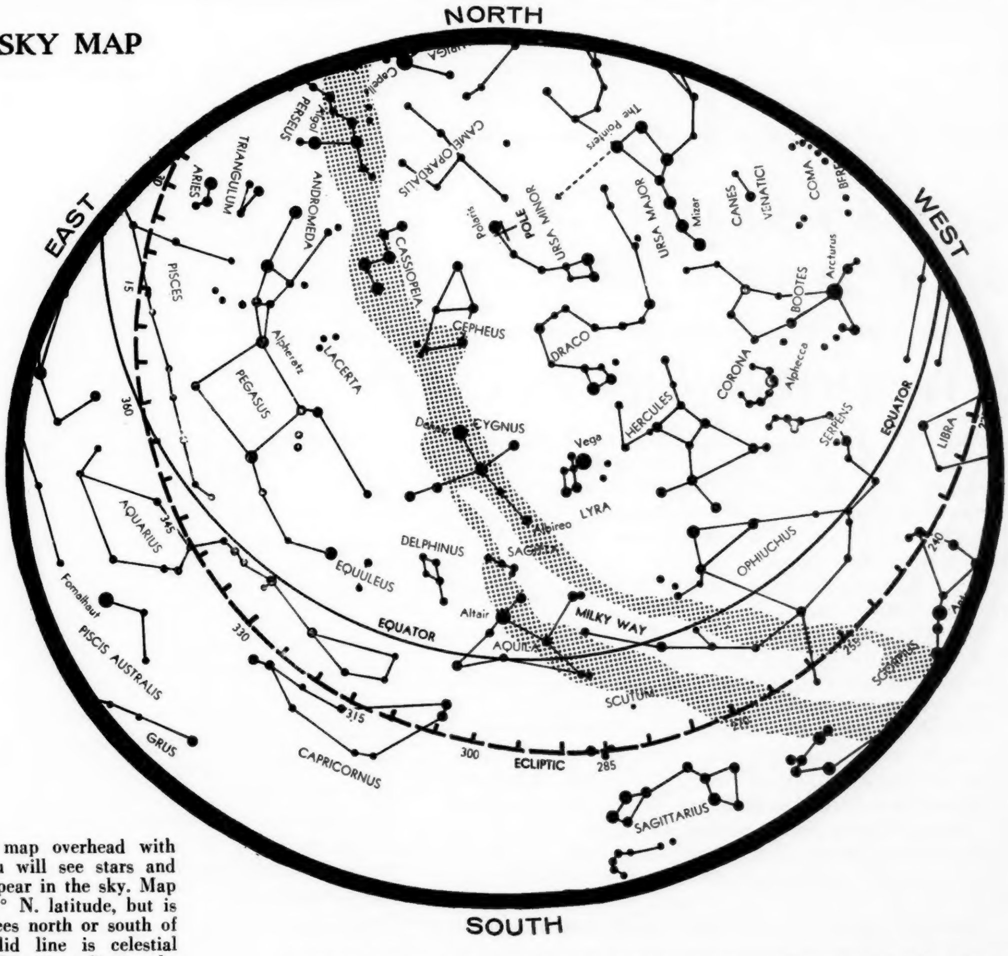
The Astronomical League, parent organization of more than a hundred astronomical societies throughout the U. S., will have its general convention this year at Haverford College, Pa., on Sept. 3-4, 1960. All interested amateurs, whether or not they are associated with clubs which are members of the League, are invited to attend the sessions and other special events.

The Haverford campus, located in a nearby suburb of Philadelphia, will be the locale for the regular sessions of the Convention. These sessions will include general business, lunar and planetary observing, subjects of interest to juniors, and the field of telescopes and accessory instruments.

The Philadelphia area holds promise of a number of interesting side trips and observing sessions. Among the special events planned are an open house on Saturday evening at the Haverford College Observatory, a visit to the Villanova University Observatory nearby, and a field trip by bus encompassing such events as visits to the well known Sproul Observatory at Swarthmore College, the observatory and planetarium of the Franklin Institute, dinner at the Edmund Scientific Co., and supper at the Spitz Laboratories in Yorklyn, Delaware. Other events will include a banquet on Monday evening, which is Labor Day.

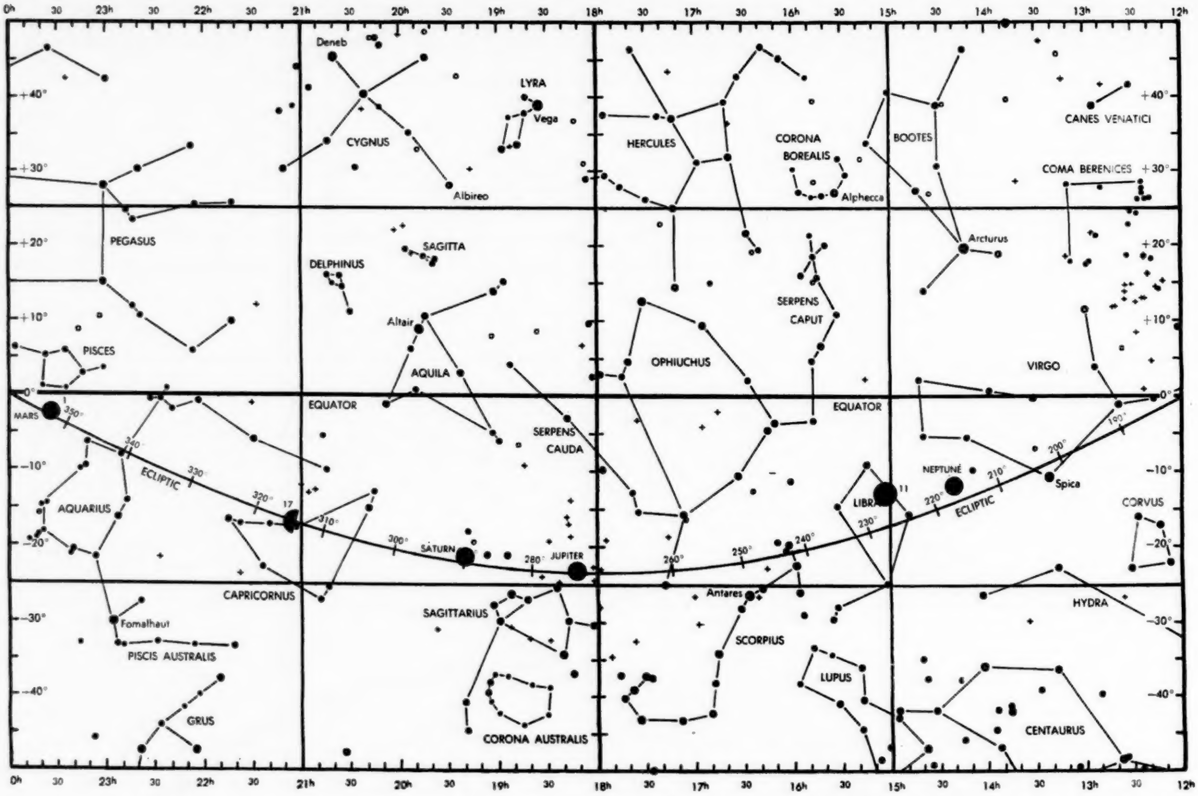
Room reservations at the Haverford College dormitories are $5.00 per day. General convention chairman Edwin F. Bailey suggests that reservations and advance registration be made before Aug. 15th to assure accommodations. Further details may be obtained from Mr. Bailey at the Franklin Institute, Philadelphia 3, Pa. Final information and program details will be published in the next issue of the SKY MAP.

MORNING SKY MAP FOR MAY



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

5:00 A.M., May 1 4:00 A.M., May 15 3:00 A.M., May 31



EQUATORIAL SKY MAP

The charts on these pages show the star field from the equator to 50° south and 50° north. Right ascension is measured from west to east in hours; each notch at the top and bottom of the charts represents 10m of right ascension. Declination is measured to the north and south of the equator in degrees plus or minus; each notch at the right and left of the chart represents 5° of declination. Longitude along ecliptic is measured in 10° segments.

MAY AMONG THE PLANETS

THE SUN: The sun moves from celestial longtitude 41° in Aries to 70° in Taurus. On the 15th its right ascension is 3h 27m and its declination is 18° 49′ N. Times of sunrise, sunset, and the beginning and end of twilight for various dates and latitudes may be found elsewhere on these pages.

THE MOON: (See the Astronomical Calendar for phases, conunctions, etc.)

MERCURY: Mercury races from Pisces through Aries and into Taurus during May, and on the 17th is in superior conjunction with the sun. This relationship is shown on the heliocentric position chart for May.

VENUS: Venus is too close to the sun in the morning sky to be observable, following much the same path as Mercury; begins month in Pisces, ends month in Taurus.

MARS: Mars is now a first-magnitude morning object in western Pisces, rising in the eastern sky during the dawn hours. However, it is just 5 seconds of arc in diameter, and requires a large telescope to show any detail.

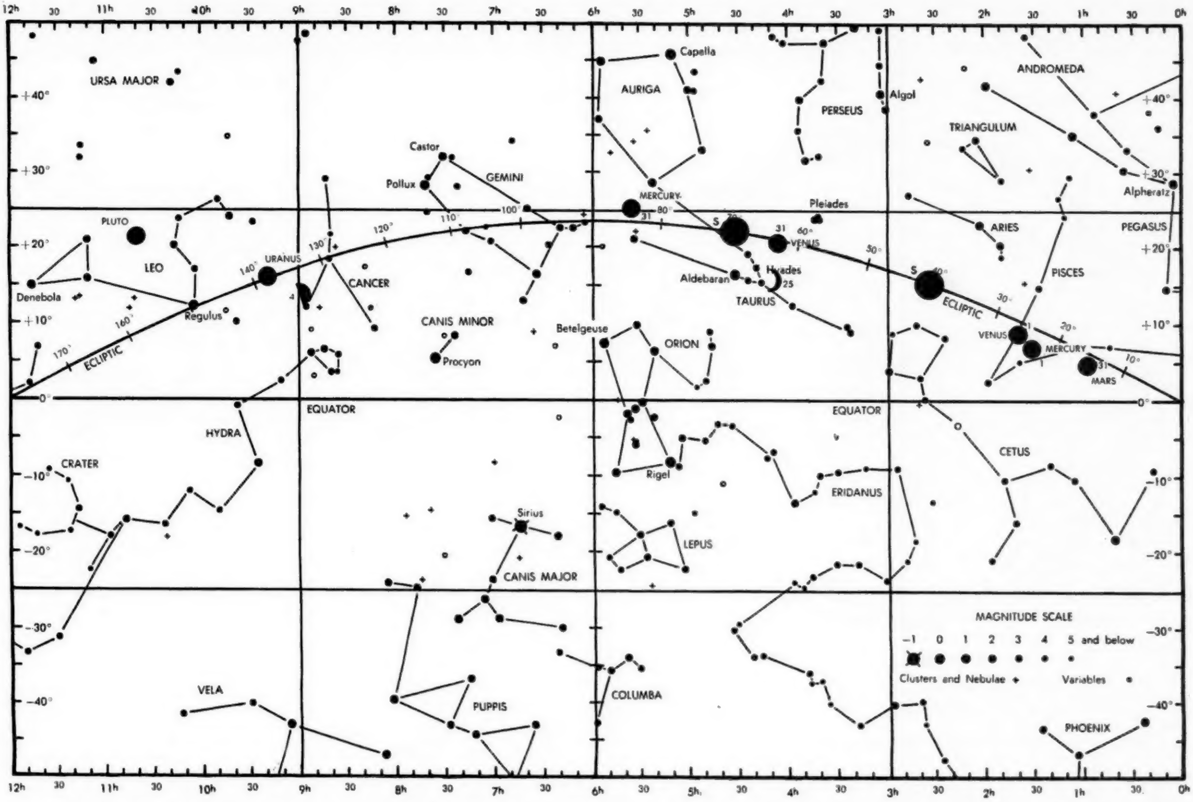
JUPITER: Jupiter is now at the meridian at dawn, but is only 27° above the southern horizon for observers in latitude 40° N. In Sagittarius, Jupiter is at its lowest possible altitude at this opposition, but high enough to make it an exciting object for small telescopes. It now exhibits a disk of 46 seconds of arc, and lights the Milky Way with its radiance (–2.1).

SATURN: Saturn is some 15° east of Jupiter in Sagittarius. On the 15th it is 0.6 magnitude; its rings are presented at a 25° angle with a diameter of 40 seconds of arc, although the ball itself is only 16 seconds, which is approximately the apparent size of Mars when it reaches opposition at the end of 1960.

Saturn's brightest moon, Titan, is visible in a small telescope at its brightest distances east and west of the planet. Look for it about 3 minutes of arc east of the planet on May 6th and 22nd; west of the planet on May 14th and 30th.

URANUS: Uranus makes a brief excursion into Cancer in late April and early May, but has resumed its direct motion now and returns to Leo. (See chart in March-April issue.)

NEPTUNE: In Libra, rising in the southeast in the early evening, and shining at 7.7. Just past opposition, showing a disk of less than 3 seconds of arc.



The charts also indicate the positions of the sun, Mercury, Venus and Mars at the beginning and end of the month; for the outer planets at the middle of the month. Position of the moon is shown for the date of its four phases. Positions are for 0h Universal Time (7:00 p.m. EST of previous day) of dates indicated.

Chart is a natural projection and contains all stars through fifth magnitude (and some fainter). Bright stars are labeled with their proper names. Clusters and nebulae in Messier's catalogue are included, as are all variable stars with maxima brighter than magnitude 8.0. Circumpolar stars may be located on the evening and morning sky maps for this month.

ASTRONOMICAL CALENDAR

MAY 1960 — Eastern Standard Time*

Date	Hour	Event
3 Tuesday	20h	First quarter moon
4 Wednesday	5h	Uranus 4° N. of moon
5 Thursday	21h	Mercury 0°.2 S. of Venus
10 Tuesday	2h	Neptune 2° S. of moon
	3h	Asteroid Pallas stationary
11 Wednesday	1h	Full moon
12 Thursday	13h	Moon at perigee (224,000 mi.)
13 Friday	20h	Jupiter 5° S. of moon
14 Saturday	22h	Saturn 4° S. of moon
17 Tuesday	10h	Mercury in sup. conjunction
	15h	Last quarter moon
19 Thursday	2h	Pluto stationary
20 Friday	17h	Mars 0°.1 S. of moon
	22h	Asteroid Vesta stationary
25 Wednesday	7h	New moon
27 Friday	23h	Moon at apogee (252,400 mi.)
31 Tuesday	13h	Uranus 4° N. of moon

*Areas on Daylight Saving Time observe time of standard time zone to their east. (CDT equals EST, etc.)

SUNRISE AND SUNSET TABLES FOR MAY

Latitude (N.)	30° SR	30° SS	35° SR	35° SS	40° SR	40° SS	45° SR	45° SS
May 1	5:18	**6:37**	5:09	**6:45**	5:02	**6:55**	4:50	**7:05**
10	5:10	**6.43**	5:00	**6:53**	4:50	**7:04**	4:37	**7:16**
20	5:04	**6:50**	4:54	**7:01**	4:40	**7:13**	4:26	**7:28**
30	5:00	**6:55**	4:48	**7:08**	4:34	**7:21**	4:18	**7:39**

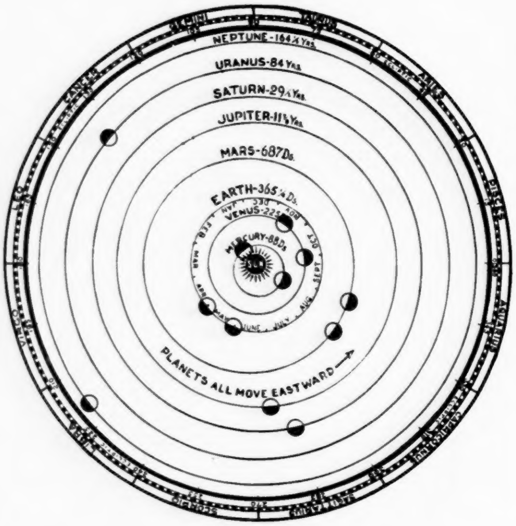
END OF EVENING TWILIGHT—BEGINNING OF MORNING TWILIGHT

Latitude (N.)	30° End	30° Beg	35° End	35° Beg	40° End	40° Beg	45° End	45° Beg
May 1	**8:04**	3:52	**8:19**	3:37	**8:38**	3:18	**9:01**	2:54
10	**8:12**	3:41	**8:30**	3:24	**8:52**	3:03	**9:20**	2:35
20	**8:22**	3:32	**8:41**	3:13	**9:06**	2:48	**9:42**	2:14
30	**8:30**	3:26	**8:52**	3:05	**9:20**	2:37	**10:01**	1:57

The tables above are designed to guide the observer in planning observing schedules and determining rising and setting times of the sun. Two corrections must be made: Latitude must be interpolated, and the local mean time of the tables must be converted to standard zone time. **Add** 4 minutes for each degree **west** of nearest standard time meridian; **subtract** 4 minutes **east** of meridian. (In areas observing daylight saving time, use standard time of zone to your east.)

Light type—a.m. **Bold type**—p.m.

HELIOCENTRIC POSITIONS OF THE PLANETS, MAY



The solar system as it would appear if viewed from a point directly above (in relation to the plane of the ecliptic) the sun. Heliocentric positions are actually measured in degrees of longitude from the center of the sun. Owing to scale, orbits of outer planets do not reflect true size. Positions at beginning and end of month are indicated for Mercury, Venus, Earth, and Mars, the others for their mean position during month.

PHENOMENA OF JUPITER'S SATELLITES

MAY 1960

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
2	3	36	II	OR	18	0	37	II	TI
3	3	10	I	SI		1	43	II	Se
4	0	30	I	ED		3	12	II	Te
	3	41	I	OR	19	1	26	I	SI
5	0	49	I	Te		2	10	I	TI
7	0	15	III	Te	20	1	40	I	OR
9	1	32	II	Te	21	2	30	III	SI
11	0	53	II	Te	25	1	43	II	SI
	2	23	I	ED		2	54	II	TI
12	0	24	I	TI	26	3	20	I	SI
	1	45	I	Se		23	48	II	OR
	2	37	I	Te	27	0	38	I	ED
	23	54	I	OR	28	0	02	I	Se
14	1	25	III	Se		0	34	I	Te
	1	51	III	TI					

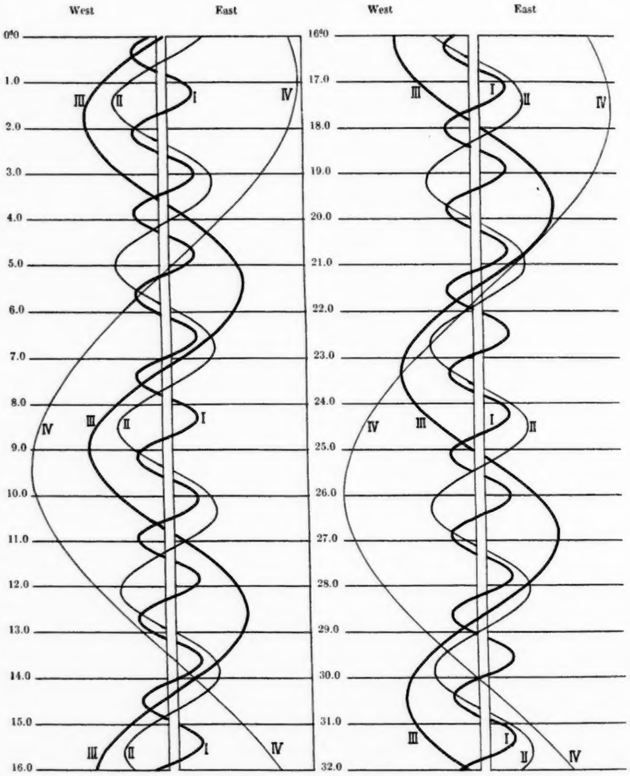
(Times EST) E—Eclipse (satellite passes into shadow of planet). O—occultation (satellite passes behind planet). T—transit (satellite or satellite shadow passes across disk of planet). S—shadow. D—disappearance. R—reappearance. I—ingress (entrance onto disk). E—egress (exit from disk).

(Data from 1960 Observer's Handbook, Royal Astronomical Society of Canada.)

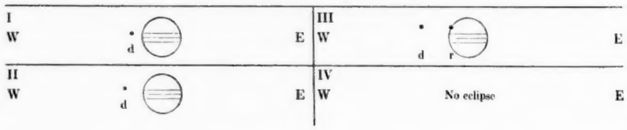
SATELLITES OF JUPITER

MAY, 1960

(Universal Time)



PHASES OF THE ECLIPSES



EXPLANATION OF SATELLITE DIAGRAM

Effective with the unification of the British and American Nautical Almanacs this year, the configurations of Jupiter's bright satellites are now presented in a new and more useful type of diagram.

The central vertical band in the diagram represents the equatorial diameter of the disk of Jupiter. The relative positions of the satellites at any time with respect to the disk of Jupiter are given by the curves. In cases where a satellite is immersed in the shadow of Jupiter or occulted by its disk, the curve is interrupted.

The horizontal lines show the positions of the satellites at 0h Universal Time (Greenwich Mean Time) for each day of the month. For example, the horizontal line for the 15th of this month would show the positions of the satellites at 7:00 p.m. on the 14th of the month for an observer in the Eastern Standard Time zone.

The diagrams at the bottom show the point of disappearance (d) into the shadow or the reappearance (r) from the shadow of each satellite (when appropriate) for the middle of the month.

(Diagram taken from 1960 *American Ephemeris and Nautical Almanac.*)

LOST IN THE STARS?

... start plotting for success!

WALTER SCOTT HOUSTON

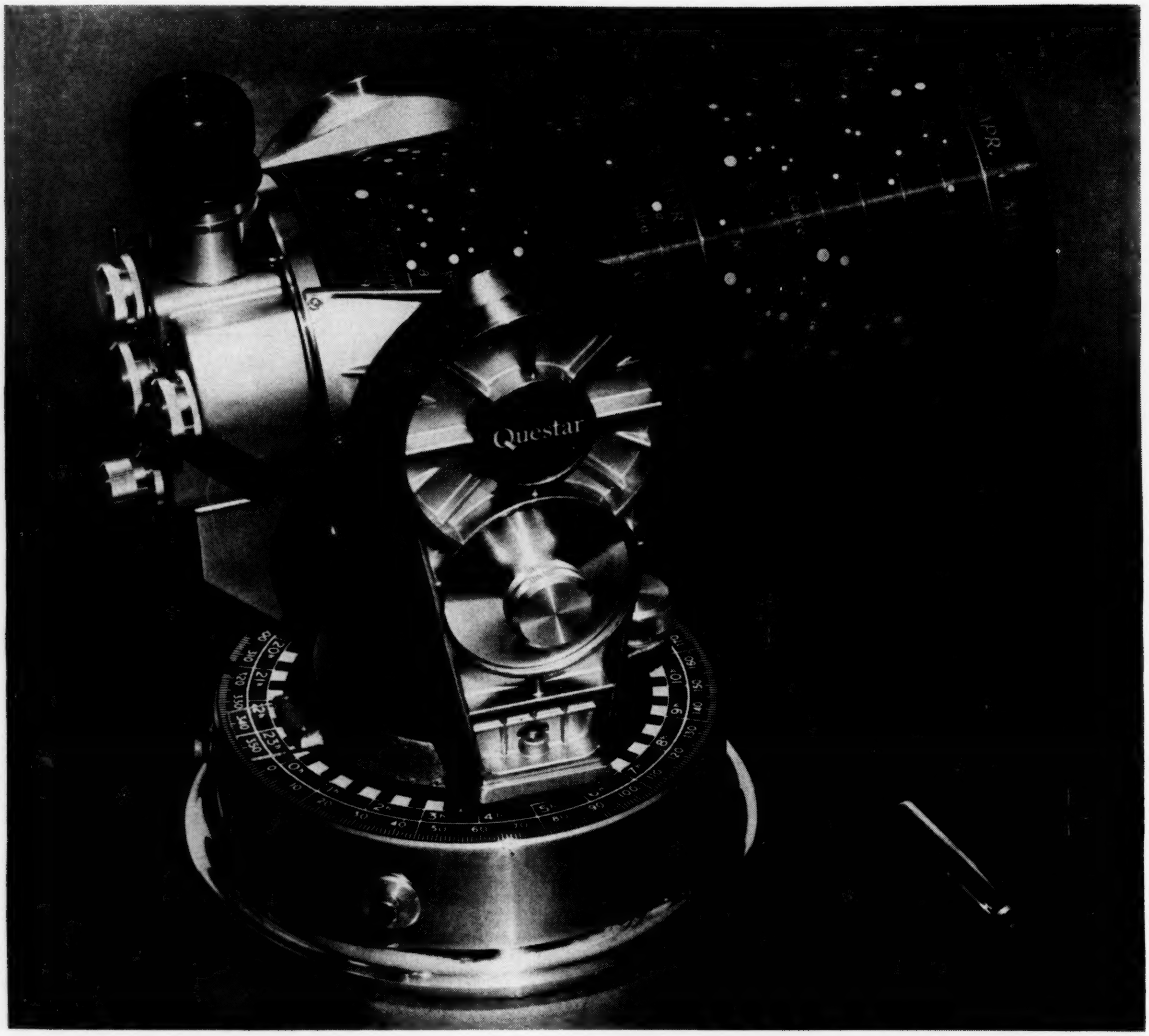
Star identification is actually a form of map reading and requires a good deal of practice. But how does one really practice? The way a great many experienced amateurs today obtained their working knowledge of the stars was by plotting meteors.

When a meteor (shooting star) arcs across the sky it often passes only over the fainter stars. If an observer tries to plot its path on a star chart he quickly discovers how well — or how poorly — he really knows his stars. Usually he finds he is in need of more study.

The ideal way to plot is to sit in a reclining chair with a small table, a flashlight covered with red cellophane, a ruler, and a star chart one can mark on. When a meteor appears, lay the ruler at arm's length along the path it took across the sky. Observe how this line runs with reference to the familiar bright stars. Then, without moving the ruler, pick up and remember some of the fainter stars along its edge.

Now proceed to the star chart. Lay the ruler on it in approximate orientation to the brighter stars. Then search along the edge for the fainter stars previously noted. (A transparent ruler is a help here.) When the fainter stars have been identified (often with several checks back against the sky) readjust the ruler to these fainter ones. This will give the path of the meteor—we hope with some accuracy.

It requires many years of practice and the use of special charts furnished by the American Meteor Society to plot meteors so that the data has scientific accuracy. But as a means of learning the fainter stars and minor constellations, nothing surpasses this method, and time flies when the novice sits down to chart these bits of glowing cosmic dust. Why not try it during some of the fine showers that will be occurring in the next few months?



LAY THAT BURDEN DOWN

When you finally get tired of lifting and carrying your telescope in and out of doors, tired of setting it up and taking it down in chilly darkness—

When you've had enough of heavy loads, of quivering tubes and images, enough of drives that falter and slow motions that fall short—

When you finally realize that it has become too much trouble to use your telescope any more because it only gives you an aching back and a pain in the neck—when you've had your fill of the contraption—*send for the Questar booklet!*

The Questar booklet will tell you how to lay your burden down. No more lifting, no more toting, no more setting up of heavy, clumsy parts. Questar weighs but 7 pounds, and is always assembled, always ready to use.

It will tell you about how Questar stands alone, the only thing of its kind, with the latest discovery in optics, the mixed lens-mirror system of the new catadioptric optics. How Questar's folded focal length keeps it fabulously short, how so short a telescope can be as stiff and rigid as a great observatory instrument. It will tell you how Questar's images are as rock steady as a microscope, how its controls are ready to your fingertips, and how its 360° continuous slow motions have a buttery smoothness with absolutely no backlash at all. It will tell you of finer performance than was ever dreamed of from only 89 mm. of aperture, and prove that point by the amazing resolution of the photographs it takes.

But hold on—let the booklet tell you this—let us use this space to tell you other things.

Let us speak, for instance, of investment value. Questar costs no more than ordinary 'scopes would if they were so well mounted as to be equally solid and vibration free. But let's face it—Questar optics cost more by the extra hours of human labor required to make, for example, mirrors that must be 16 times more accurate of figure than the ordinary kind. Questar's mounting, too, has over 235 separate parts, each one of the best procurable alloys down to the last tiny screw.

So let us tell you what we have found out—that Questars are so greatly in demand that the few which reach the second-hand market depreciate an average of less than 7% per year! Imagine this—Questars over three years old bring 80% of their purchase price! We know of nothing manufactured with such amazingly high value at resale.

Remember then, that if you too become a Questar owner, you will be making the most conservative investment possible. We firmly believe that it will cost you less per year to enjoy a Questar.

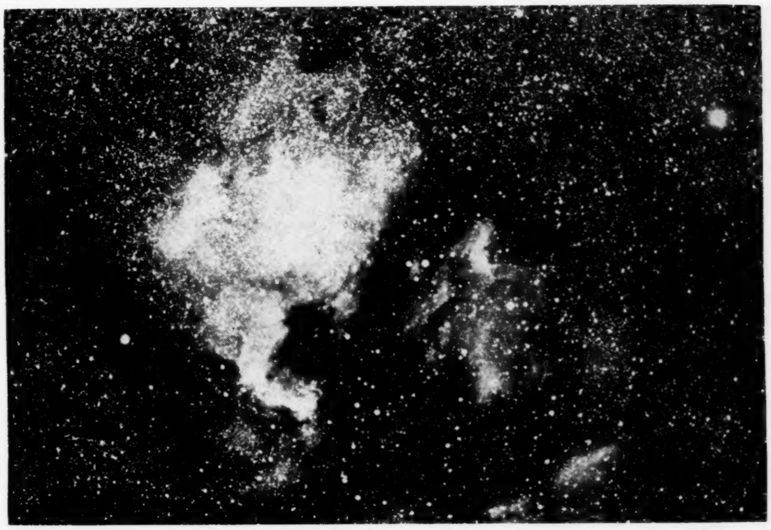
Questar, as illustrated, still costs only $995 postpaid, in hand-made, velvet-lined English leather case. Terms are available. May we send you the booklet?

Questar

BOX 40 · NEW HOPE · PENNSYLVANIA

THROUGH THE THREE-INCH

The profit of occasional pre-dawn observing sessions has never been more evident than during the past few months. At the beginning of 1960 no planets were visible in the evening sky, although they were staging a magnificent parade in the early twilight of dawn. Only now are Saturn and Jupiter moving into the late evening heavens, yet they have been interesting objects for some time. Small-hour watchers of the sky have also been able to observe the advent of a nova, or "new" star, on the border between Aquila and Hercules. This nova was a 5th magnitude object in March, but is now fading rapidly.



The North American Nebula in Cygnus, so named for its obvious resemblance to our continent, is pictured here in a photograph made by Alan McClure of Los Angeles. Exposure was 55 minutes with an f/5 Goto lens of 20-inch focal length. Star at upper right is Deneb. On dark clear nights this object is faintly visible to good eyes in binoculars or small, short-focus telescopes.

Besides welcoming this new star, dawn observers also had a chance to note the temporary demise of an old friend, the erratic variable star R Coronae Borealis. It had remained at or near maximum since 1953, when suddenly in February the variable began to fluctuate and begin its drop to minimum. At the end of March the writer observed it a 10.3 with the 3-inch Fitz.

Earlier that month, while attempting to point out the variable to a beginning observer as it rose through the city's foggy curtain (it would have been high in the dawn hours), the writer had been disturbed by the novice's apparent inability to follow instructions and locate R Coronae, which is nestled within the encircling jewels of the Northern Crown. A quick check explained this, because the star, usually about 6th magnitude, was not to be seen, although stars of the 9th magnitude were visible through the bright and dirty skies of the eastern horizon.

As a final enticement to the early riser, we will call your attention to the early dawn observation of Comet Burnham 1959k by Alan McClure, whose photo of Comet Burnham appears elsewhere in these pages. He managed to "trap" the object during those few days between its return from behind the sun and the arrival in the morning sky of the past-full moon.

However, never let it be said that this writer recommended over-indulgence in this type of thing. He personally does not make a regular habit of prowling the heavens during the dawn hours. It is his opinion that man was not intended to function normally at four in the morning —although it is open to question whether the pursuance of the stargazer's quest is actually a normal function!

* * *

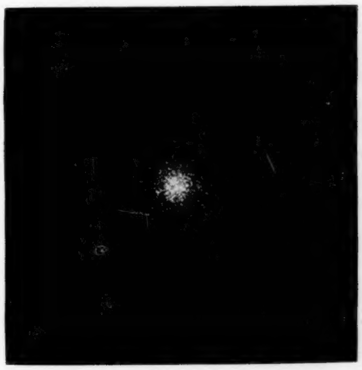
By late May Hercules sprawls high in the northeastern sky at the end of twilight, holding the promise of reunion with several old friends. The first and best remembered of these is the great globular cluster, M13. What the comet hunter Messier must have thought upon encountering this magnificent object! Nevertheless, it was not what he was looking for, so he shrugged it off as another bothersome "nebula," numbered it 13 (for bad luck?) in his catalogue, and moved on.

Pictured here is M13 as recorded in a short 15-minute exposure with the 60-inch reflector at Mt. Wilson. A good-size amateur reflector would show a similar view, although the center would not be so well resolved.
Mt. Wilson & Palomar Observatories

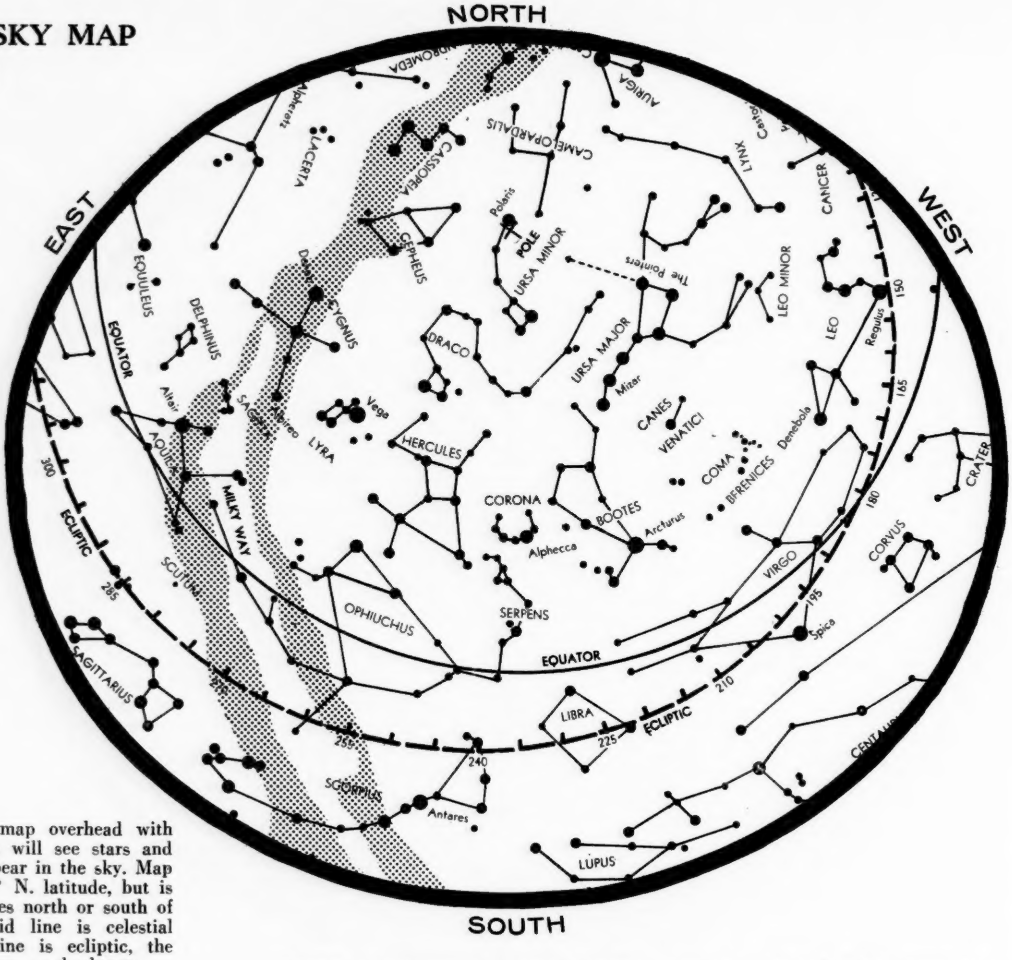
But today we can see it, not only with our small instruments, but through the eyes of great telescopes with their sensitive photographic retinas—and further delineated by the inquiring mind of man.

It is appropriate that this object—a bright but blurry jewel studded in the Keystone of Hercules—has no formal proper name. How could a name describe it? Although its 25 brightest stars average but 15th magnitude, this glowing globe of some 100,000 suns is an easy naked-eye object in dark skies.

(Continued on Next Page)



EVENING SKY MAP FOR JUNE



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

10:00 P.M., June 1 9:00 P.M., June 15 8:00 P.M., June 30

(*Continued From Page* 15)

In a small instrument the cluster is actually not resolvable into individual stars, even at the cluster's edges, but by averting your vision (looking off to one side of the field and letting the sensitive outer retina do the work) you will perceive a certain graininess in the texture of the cluster. Use a medium-high power for this—about 100X. What you are actually doing is to resolve small clumps of brighter stars within the globular.

This object is actually some 325,000 light years from us, as determined by our galactic "yardsticks," the cluster variables. If M13 were brought to the distance of 325 light years—10 parsecs, a standard distance for determining the absolute brightness of stars—it would blaze forth with the light of 400,000 of our suns, says Otto Struve.

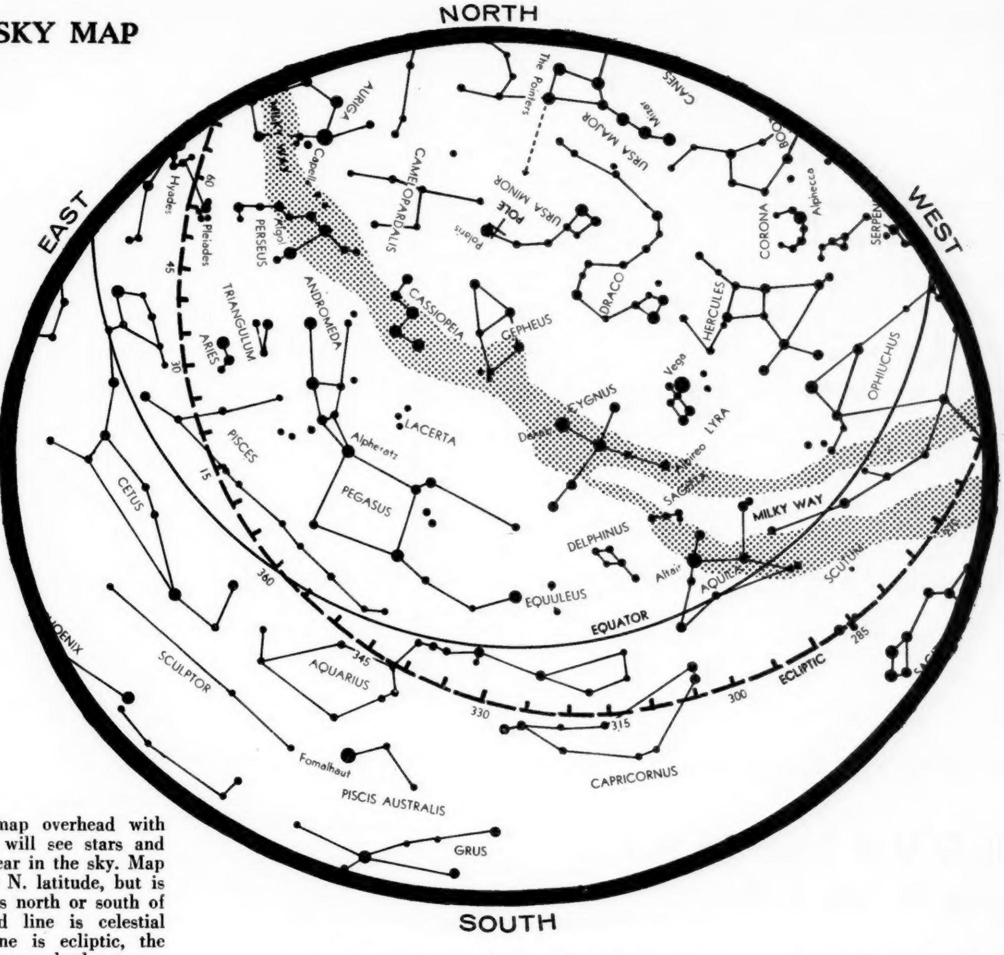
M13 can be located as a small cross on the western edge of the Keystone in Hercules by using the equatorial charts elsewhere in this magazine. (R.A. 16h 40m, Dec. 36° 32′ N.)

Also a visual object in dark skies is M92, another globular just a few degrees north of the Keystone at R.A. 17h 16m, Dec. 43° 11′ N. Similar to M13, but a bit fainter and slightly less extensive.

Another must stop among the array of globulars is M3, located about 10° to the northwest of Arcturus in Canes Venatici. Scarcely fainter than M13, it gives this observer the impression that he can begin to resolve it in a 4-inch telescope. In observing, to "know what you are looking for" can be both a help and a hindrance. Tell us if you think you can resolve it, and if so, with what size and kind of telescope. Its coordinates are R.A. 13h 40m, Dec. 28° 35′ N.

We recall the story told by a friend from Missouri who, while on vacation, was walking along a desert road in the Southwest during the late spring. Directly ahead he was struck

MORNING SKY MAP FOR JUNE



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

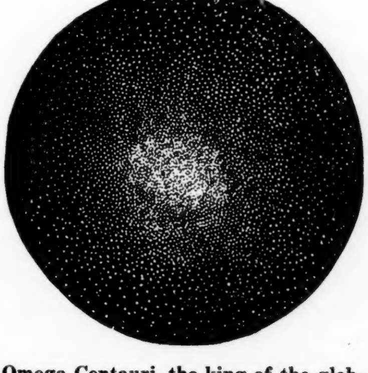
5:00 A.M., June 1 4:00 A.M., June 15 3:00 A.M., June 30

by a hazy glob of light that kept boring into his retina. As familiar with the stars as anyone, he walked for several minutes before he realized that he was seeing the great southern globular, Omega Centauri—so bright (3rd magnitude) that it was given a Greek-letter designation.

Located at R.A. 13h 24m, Dec. 47° 16′ S., this great blaze of fire is visible—though a bit diminished in brightness—to any persevering observer south of 40° latitude. Here's an easy way to spot it: On May 15th at about 9:30 p.m. (local standard time), the bright star Spica in Virgo is on the southern meridian. Fix your eye, binoculars, or telescope (with low power) on Spica, then carefully drop your gaze some 35° downward. At the latitude of Memphis, Omega Centauri will be about 10° above the horizon, and thus diminished only a magnitude or so by atmospheric extinction. Theoretically, and aided by refraction, the cluster should be barely visible to an observer in the latitude of Milwaukee, assuming clear air and a water horizon.

Far-fetched? Perhaps, but these globulars are worth reaching out for!

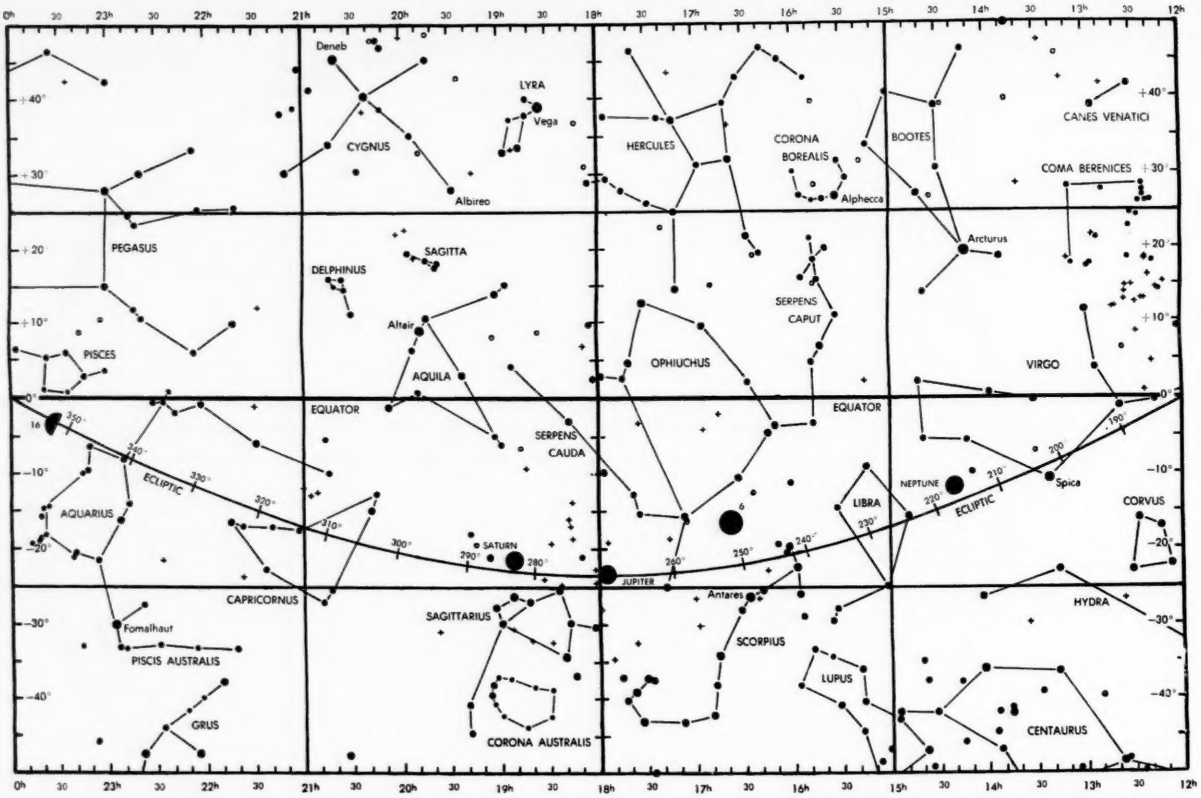
—DDZ



Omega Centauri, the king of the globular clusters, as drawn by a 19th-century astronomer using a medium-size telescope. From Celestial Atlas.

BULLETIN

NASA announced at press time that its 100-foot Echo balloon satellite was scheduled to be launched at Cape Canaveral between 4 and 5 p.m. on May 5th. U. S. observers may have a chance to observe three SW-to-NE passes each evening during the first two weeks. The satellite should be at least a 1st magnitude object.



EQUATORIAL SKY MAP

The charts on these pages show the star field from the equator to 50° south and 50° north. Right ascension is measured from west to east in hours; each notch at the top and bottom of the charts represents 10m of right ascension. Declination is measured to the north and south of the equator in degrees plus or minus; each notch at the right and left of the chart represents 5° of declination. Longitude along ecliptic is measured in 10° segments.

JUNE AMONG THE PLANETS

THE SUN: The sun moves from celestial longitude 70° to 99° during June, from Taurus into Gemini. On June 15th its right ascension is 5h 33m and its declination is 23° 18′ N. On June 21st at 4:43 a.m. EST the sun reaches the summer solstice, its farthest point north of the celestial equator, and summer officially begins. Times of sunrise, sunset, and the beginning and end of twilight for various dates and latitudes may be found elsewhere in these pages.

THE MOON: (See Astronomical Calendar.)

MERCURY: Mercury speeds from superior conjunction in mid-May to its greatest eastern elongation a month later on June 19th. It may be spotted in Gemini south of Pollux at this time, 0.8 in magnitude but elusive in the evening twilight. Appears as a small crescent of 8 seconds of arc.

VENUS: Venus follows Mercury into superior conjunction with the sun, arriving at this position on June 22nd. Not observable.

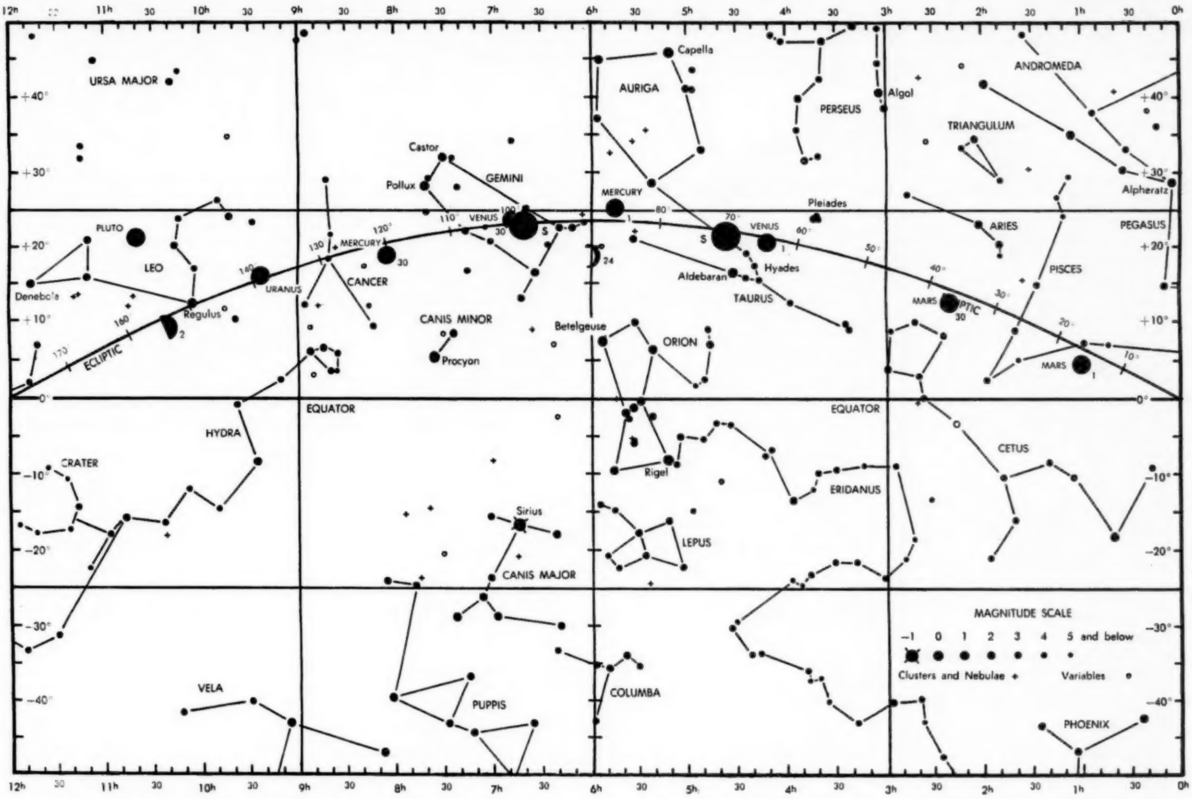
MARS: Mars moves from Pisces in Aries, rising some three hours before sunrise. Its disk is just 6 seconds of arc, it is still of little more than passing interest to the dawn observer.

JUPITER: Jupiter reaches opposition in Sagittarius on June 19th, rising at sunset and southing at midnight, local standard time. The planet's low altitude at this opposition, although affecting the steadiness of its telescopic image, is an advantage to users of refractors, since the planet can be viewed without resort to reversing diagonals or discomforting contortions.

SATURN: In Sagittarius, an interesting object in the late-evening sky. Titan, its brightest satellite (8th), was first observed and recorded by Huygens more than 300 years ago in a two-inch instrument. You will find it an easy object in small instruments at the following dates during June: east of the planet (right in inverting telescopes) on the 7th and 23rd—west of the planet (left) on the 15th. On these dates the satellite, which is larger than our moon, is at its greatest elongations east and west of the planet and therefore less obscured by the primary's brightness.

URANUS: In Leo and low in the west after sunset. On the 15th it is at right ascension 9h 23m and declination 16° 04′ N., and shining at magnitude 6.

NEPTUNE: Neptune is in Libra, an evening object. On the 15th it is in right ascension 14h 20m and declination 12° 01′ N.



The charts also indicate the positions of the sun, Mercury, Venus and Mars at the beginning and end of the month; for the outer planets at the middle of the month. Position of the moon is shown for the date of its four phases. Positions are for 0h Universal Time (7:00 p.m. EST of previous day) of dates indicated.

Chart is a natural projection and contains all stars through fifth magnitude (and some fainter). Bright stars are labeled with their proper names. Clusters and nebulae in Messier's catalogue are included, as are all variable stars with maxima brighter than magnitude 8.0. Circumpolar stars may be located on the evening and morning sky maps for this month.

ASTRONOMICAL CALENDAR

JUNE 1960 — Eastern Standard Time*

Date	Hour	Event
2 Thursday	11h	First quarter moon
6 Monday	12h	Neptune 2° S. of moon
9 Thursday	8h	Full moon
	21h	Moon at perigee (222,100 mi.)
10 Friday	2h	Jupiter 5° S. of moon
	13h	Asteroid Juno at opposition
11 Saturday	5h	Saturn 4° S. of moon
16 Thursday	0h	Last quarter moon
18 Saturday	14h	Mars 2° N. of moon
19 Sunday	9h	Mercury greatest elongation E (25°)
	21h	Jupiter at opposition
20 Monday	0h	Mercury 6° S. of Pollux
21 Tuesday	5h	Solstice (summer begins)
	23h	Aldebaran 0°.3 S. of moon
22 Wednesday	11h	Venus in superior conjunction
23 Thursday	22h	New moon
24 Friday	5h	Moon at apogee (252,700 mi.)
26 Sunday	4h	Mercury 3° N. of moon
27 Monday	21h	Uranus 3° N. of moon
28 Tuesday	16h	Asteroid Ceres stationary

*Areas on Daylight Saving Time observe time of standard time zone to their east. (CDT equals EST, etc.)

SUNRISE AND SUNSET TABLES FOR JUNE

Latitude (N.)	30°		35°		40°		45°	
	SR	SS	SR	SS	SR	SS	SR	SS
June 1	5:00	**6:56**	4:47	**7:08**	4:34	**7:22**	4:16	**7:39**
10	4:58	**7:01**	4:46	**7:14**	4:31	**7:28**	4:14	**7:46**
20	4:59	**7:03**	4:46	**7:16**	4:31	**7:32**	4:13	**7:50**
30	5:02	**7:05**	4:49	**7:18**	4:34	**7:32**	4:16	**7:50**

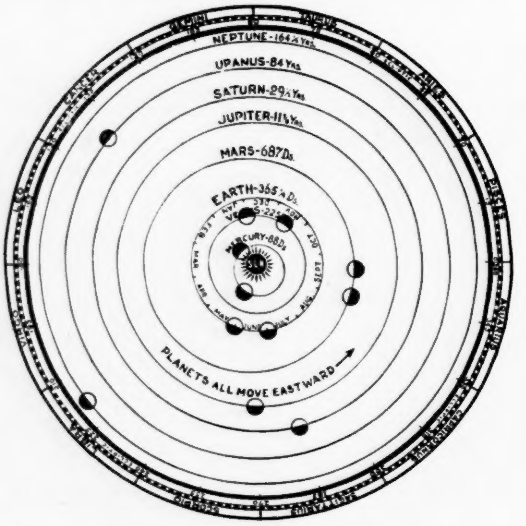
END OF EVENING TWILIGHT—BEGINNING OF MORNING TWILIGHT

Latitude (N.)	30°		35°		40°		45°	
	End	Beg	End	Beg	End	Beg	End	Beg
June 1	**8:31**	3:26	**8:53**	3:04	**9:21**	2:35	**10:02**	1:53
10	**8:37**	3:22	**9:00**	2:59	**9:30**	2:29	**10:17**	1:44
20	**8:40**	3:22	**9:03**	2:59	**9:35**	2:28	**10:23**	1:40
30	**8:41**	3:26	**9:04**	3:02	**9:35**	2:31	**10:22**	1:44

The tables above are designed to guide the observer in planning observing schedules and determining rising and setting times of the sun. Two corrections must be made: Latitude must be interpolated, and the local mean time of the tables must be converted to standard zone time. **Add** 4 minutes for each degree **west** of nearest standard time meridian; **subtract** 4 minutes **east** of meridian. (In areas observing daylight saving time, use standard time of zone to your east.)

Light type—a.m. **Bold type**—p.m.

HELIOCENTRIC POSITIONS OF THE PLANETS, JUNE



The solar system as it would appear if viewed from a point directly above (in relation to the plane of the ecliptic) the sun. Heliocentric positions are actually measured in degrees of longitude from the center of the sun. Owing to scale, orbits of outer planets do not reflect true size. Positions at beginning and end of month are indicated for Mercury, Venus, Earth, and Mars, the others for their mean position during month.

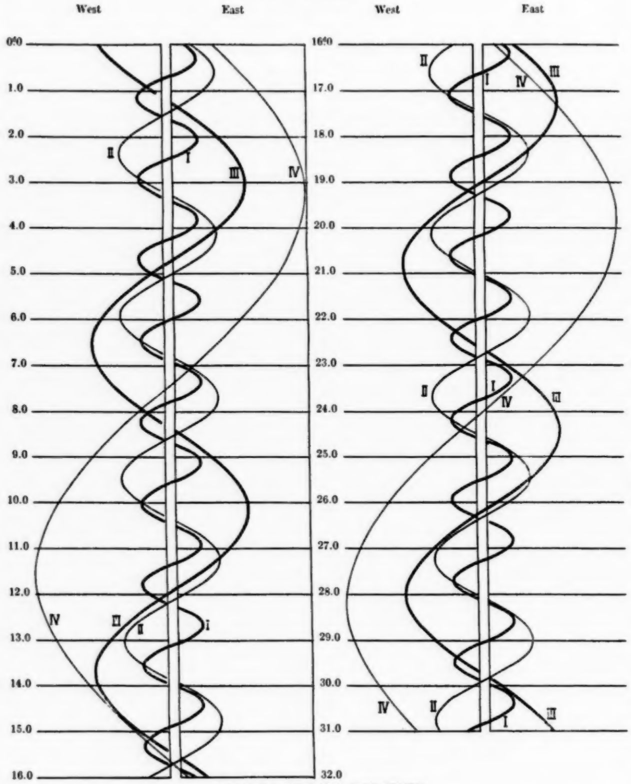
PHENOMENA OF JUPITER'S SATELLITES
JUNE 1960

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	1	12	III	OR	19	0	48	I	ED
2	22	38	II	ED		1	17	II	Se
3	2	05	II	OR		1	19	II	Te
	2	32	I	ED		3	02	I	OR
	23	43	I	SI		22	00	I	TI
4	0	06	I	TI		22	00	I	SI
	1	56	I	Se	20	0	13	I	Te
d	h	m	Sat.	Phen.		0	14	I	Se
	2	19	I	Te		21	29	I	ER
	23	35	I	OR	25	21	50	III	TI
8	0	25	III	ED		22	24	III	SI
10	1	14	II	ED	26	0	43	III	Se
11	1	37	I	SI		0	58	II	TI
	1	50	I	TI		1	15	II	SI
	22	43	II	Se		1	22	III	Se
	22	54	I	ED		2	33	I	OD
	23	05	II	Te		23	44	I	TI
12	1	18	I	OR		23	55	I	SI
	22	19	I	Se	27	1	58	I	Te
	22	29	I	Te		2	08	I	Se
18	21	22	III	Se		20	59		OD
	21	27	III	Te		22	26	II	ER
	22	41	II	SI		23	24	I	ER
	22	44	II	TI					

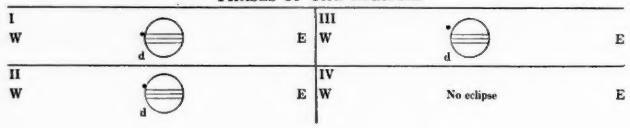
(Times EST) E—eclipse (satellite passes into shadow of planet). O—occultation (satellite passes behind planet). T—transit (satellite or satellite shadow passes across disk of planet). S—shadow. D—disappearance. R—reappearance. I—ingress (entrance onto disk). E—egress (exit from disk).

(Data from 1960 Observer's Handbook, Royal Astronomical Society of Canada.)

SATELLITES OF JUPITER
JUNE, 1960
(Universal Time)



PHASES OF THE ECLIPSES



EXPLANATION OF SATELLITE DIAGRAM

Effective with the unification of the British and American Nautical Almanacs this year, the configurations of Jupiter's bright satellites are now presented in a new and more useful type of diagram.

The central vertical band in the diagram represents the equatorial diameter of the disk of Jupiter. The relative positions of the satellites at any time with respect to the disk of Jupiter are given by the curves. In cases where a satellite is immersed in the shadow of Jupiter or occulted by its disk, the curve is interrupted.

The horizontal lines show the positions of the satellites at 0h Universal Time (Greenwich Mean Time) for each day of the month. For example, the horizontal line for the 15th of this month would show the positions of the satellites at 7:00 p.m. on the 14th of the month for an observer in the Eastern Standard Time zone.

The diagrams at the bottom show the point of disappearance (d) into the shadow or the reappearance (r) from the shadow of each satellite (when appropriate) for the middle of the month.

(Diagram taken from 1960 *American Ephemeris and Nautical Almanac.*)

YOUR TELESCOPE AND MINE

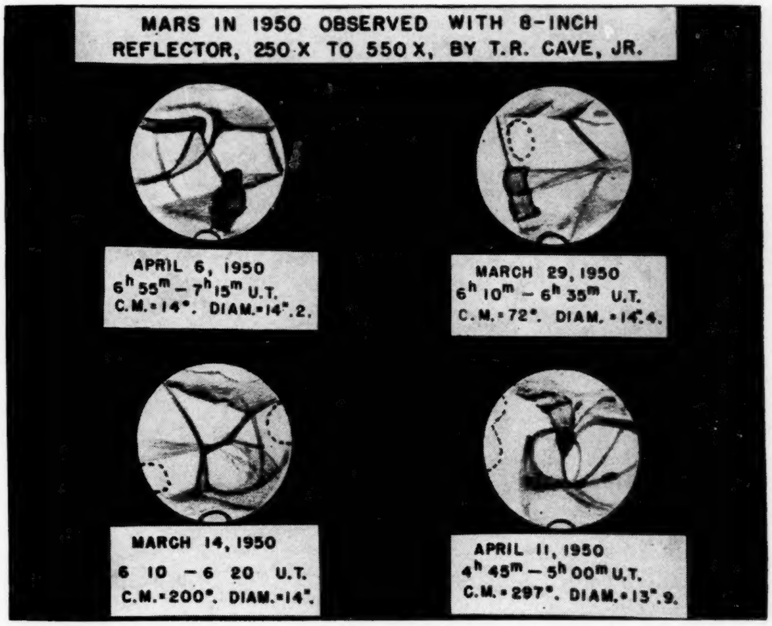
THOMAS R. CAVE, JR.

It has been nearly 35 years since amateur astronomers in America began building their own reflecting telescopes. During this time several hundred thousand telescope mirrors have been started, and undoubtedly a large percentage of these were finished and mounted in homemade telescopes. At the same time, probably a very large proportion of all these telescopes have given considerably less than perfect performances. Since many of these telescopes have been first attempts by beginners, basic optical errors alone can easily account for a large number of imperfectly performing instruments. However, there are several other important considerations that should be followed besides having the best possible mirror and diagonal.

Far too many beginners fail to give careful thought to the selection of eyepieces. No good reflector of f/6 to f/9 focal ratio can ever give optimum performance unless provided with orthoscopic oculars, particularly when medium and high powers are used. Good Kellner and Erfle eyepieces work quite well at lower magnifications, but orthoscopics are a must for the best results with high powers. Several lines of orthoscopic oculars are available today. An observer will do much better with two good orthoscopic oculars than with a half-dozen low-priced ordinary ones. Unless a Newtonian reflector is f/12 or larger, a Huygenian ocular will never perform well, since this is primarily designed for use with refractors.

A good achromatic and coated Barlow lens is always a tremendous help in obtaining high magnifications when used with a good medium-power ocular; most serious observers find them a vital accessory to their ocular collection. There are several good achromatic Barlows on the market at this time.

Besides a first-quality mirror, a good diagonal, and a few fine oculars, the telescope tube itself is of prime consideration. Ideally, the tube should be made of a non-metallic material. Since metal absorbs and radiates heat readily, a more thermally stable material is always desirable. A tube made of wood can be easily



These drawings of Mars made ten years ago by Tom Cave during the 1950 opposition of Mars show what a properly performing telescope, plus a trained observer, can do. Cave used a home-made 8-inch reflector in making these drawings, which were intentionally exaggerated in contrast for purposes of reproduction.

constructed and yet be reasonably light in weight and very inexpensive to build. A square, slender frame of wood covered with tempered 1/8th-in. Masonite is very cheap and easy to build. Plastic or Fiberglas tubes are equally good and are considerably lighter in weight than wooden tubes. The tube should be one to two inches larger than the telescope mirror in the case of a small reflector and two or three inches larger and apertures of ten inches and greater.

If several small component parts are being homemade, a mirror cell of wood is usually the easiest to fabricate and the most efficient thermally. The mirror should never be cemented to the cell, but should be retained in place by light clips. All contact areas should be insulated (against both thermal and shock effects) with cork, felt or some similar material, and the mirror given a few thousandths of an inch of clearance from

(*Continued on Page* 22)

(*Continued From Page* 21)

the cell. The mirror cell should also be of open construction and the end of the tube behind the mirror should not be closed, since the surrounding air should circulate freely about the mirror, allowing it to remain as much as possible at the same temperature as the air.

The diagonal mirror support, commonly called the "spider," has had nearly as many designs as telescope mountings themselves. Today there are two main schools of thought regarding spiders — divided between those who use the types with either three or four straight vanes and those preferring curved vanes using one or two full circles of metal for supporting the diagonal and holder. Personally, this writer likes the straight four-vane variety. The popular three-vane spider produces six spikes on bright stars, while the four-vane mount causes only four spikes to be seen. Any form of curved spider will eliminate the spikes by distributing the diffraction evenly around a bright star image, but increased diffraction effects are introduced and bright objects tend to be surrounded by a faint nebulous fog. In one field of observing the writer has found the curved or circular type of spider ot be of value, and that is in viewing double stars when the companion star is close and considerably fainter than its primary. In other fields of observing the curved spider does not appear to have any special advantage, and in planetary observing it seems to have certain disadvantages.

The focusing device for the eyepiece should be carefully considered, for reflectors of normal focal lengths have a much more critical focus than long-focus refractors. The standard rack-and-pinion device is ideal on the refractor, but is frequently found a bit too coarse for precision focusing on a short-focus reflector. A helical focuser combined with a rack and pinion is ideal, since it allows for both rapid focusing travel and minute final adjustment.

Regardless of how well the telescope has been constructed, good definition can never be obtained unless the optical components are quite accurately lined up. It is impossible to achieve perfect alignment of a reflector in the daytime, although optical alignment can be approached. The delicate final adjustments should be carefully done on a star image at night. Perhaps the best type of object to use is a small planetary disk, such as one of the satellites of Jupiter or the disc of Uranus.

If reasonable attention is given to these points during the construction of the telescope, and if the optical components are good and the telescope mounting is steady, the performance and definition of your telescope should be excellent.

Illustrated above, equatorial mounting of the 4" UNITRON refractor, Model 152. This model sells complete for only $785.

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